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THE PRODUCTION
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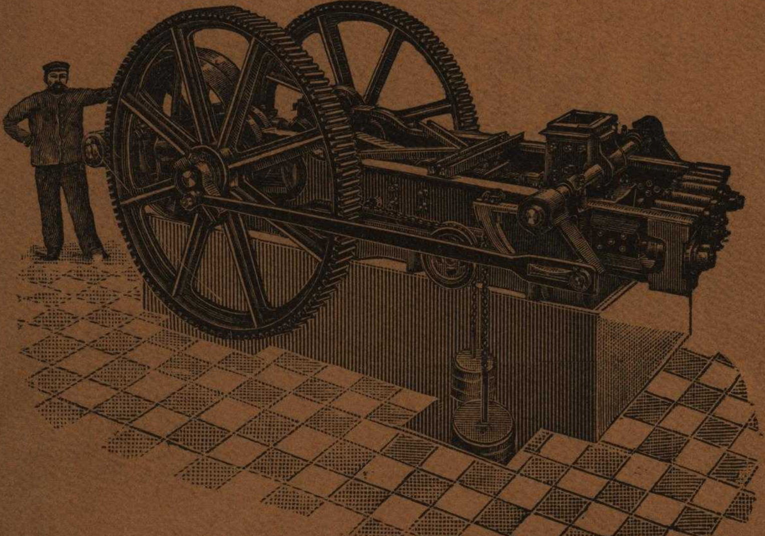
# BRICKS
FROM
GRANULATED HIGH FURNACE SLAG AND LIME.



BRÜCK, KRETSCHEL & Co.
CONSTRUCTING ENGINEERS AND IRON FOUNDRY
OSNABRÜCK 1906.

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THE PRODUCTION OF BRICKS FROM GRANULATED HIGH FURNACE SLAG AND LIME

BRÜCK, KRETSCHEL & Co.
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As far back as 1866, Bricks produced from granulated high furnace slag and lime, were produced by the engineer Mr. Fritz W. Lührmann, now residing in Berlin This was the first step to utilise a waste material which up to that period had been considered as worthless and cumbersome. The hand-presses which had first been used and did not answer the purpose because of their reduced pressing power, were later on replaced by mechanically driven presses, working with increased power and precision, the system of which has up to date not been changed, though many improvements have since been applied to them.

The novel industry made but little progress in the beginning and it lasted about twenty years after having been started, until a remarcable development took place, the manufacture of bricks from granulated slag having attained nowadays a considerable importance

With a view fully to answer the many inquiries addressed to us concerning these bricks, we shall in the following discuss all the items which we deem important for the installation and the exploitation of a manufactory of slag-bricks.

As to the raw material, i. e. the *slag*, we must first of all observe that it can only be used in its *granulated state,* which as is well known is obtained by uniting it with water on emerging from the high furnace and consequently still in a liquid state, whereas any other kind of slag, as for instance ground lump-slag, will not answer the purpose, the bricks produced from them lacking compactness.

In the beginning the so-called light slag, drawn on producing cast or Bessemer-iron was, alone, considered adapted for the purpose, but this was less owing to the condition of the slag than to the construction of the press, which was not powerful enough for properly moulding the heavy slags; but after having considerably reinforced the machine. for particulars of which we refer to our special prospectus, heavy slags, too, such as are drawn on producing Thomas- and Martin-iron, could be used, giving excellent bricks. In those works where different sorts of iron are produced, it has proved very advantageous to accumulate the slags indifferently in large heaps, this proceeding giving excellent results, the heavy and light slags mixing easily and furnishing an excellent material for moulding.

It can be asserted that in general all high furnace slags are at present adapted for the fabrication of bricks. If there exist any doubts in this respect we are prepared to make essays, free of charges, with any material which will be remitted to us, freight prepaid, the bricks which if required will be moulded in the very presence of the interested parties constituting the basis of the guaranty which we shall be able and willing to grant as to the quality of the produce.

For producing the mortar ordinary or hydraulic lime is used in the proportion of from 7 to 10 $^0/_0$. The lime may be used either unslacked and pulverized or slacked in the form of lime-milk or pulverized, the latter method having proved very efficient, as it allows of an immediate compression of the mortar. On using pulverized quick lime the slackening process takes place during or after its mixture with the wet slag.

This method produces a more plastic mortar easily to be moulded, offering however the drawback, that according to the quicker or slower slacking process of the lime it will be necessary to suffer the mortar to rest during a shorter or longer period previous to its being moulded, for bricks made with a mortar mixed with but partially slacked lime will, infallibly, become cracked and thus unfit for use. There are some high furnace works who can do without lime, the slags of which being possessed of so high a percentage of lime that it pulverizes when exposed to the open air without being granulated; and this slag can be used for moulding bricks without any further admixture, their hardening requiring withall a longer period.

As a rule we prefer to employ for preparing the mortar pulverized slacked lime. Certain lime-burners sell this produce under the denomination of „Bag-Lime“; it is at all events very easy to produce it oneself by plunging baskets filled with quick lime into water or more rationally still by means of a lime slacking-drum, thus avoiding the obnoxuous lime dust.

The fabrication of slag-bricks is best explained by the annexed plates. It begins with mixing the raw materials, and the more intimately they are mixed and the more evenly the lime is distributed in the mortar, the better will the brick turn out afterwards. For this purpose we have constructed a mixing-machine, as explained in our special prospectus to which we refer for particulars, the which has proved highly efficient since the very beginning. This apparatus is often combined with a cylinder crushing the bubbles still existing in the slag and removing an excess of moisture.

PLATE I shows a plant after the older system. To facilitate the fermentation of the mortar each press has two mixing-machines, each of which being able to supply sufficient mortar for the press, the mixing machines working by turns. The slag and the lime are conveyed as far as in front of the mixing machine in tilting-cars or bags and thrown in the right proportion through the opening-a-. The mixture having been duly performed, the material issues automatically at-b-, when it will rest for a couple of hours. Thereupon it is shoveled into the funnel of the press-d-, the bricks emerging at-f, to be loaded on cars at the right and left. For hardening the bricks are piled up in the open air as many as 12 one above the other and at the end of 3 or 4 weeks they may already be made use of and from 2 to 3 months later on the bricks are transportable without running the risk of being damaged.

At the end of a year the brick will show upon an average a resistance of 110 kg. per cm sq. further hardening occurrring during the next 10 and more years. A low temperature will retard the hardening of the bricks and frost will destroy it, and for this reason it will be necessary to build a steam-heated shed if one wants to work also in winter time, large enough to hold the output of a month. The thus dried bricks will generally stand severe cold at the end of a fortnight.

PLATE II represents a better executed plant requiring fewer workmen. In this plant the mixing-apparatus are erected above the presses. The proceeding is as follows: The granulated slag is carried along in cars containing each of them about the same quantity and thrown on the grating over the worm -a- this conveying-screw preparing the mixture of the material and conveying it tho the elevator-b-, by which it is raised and dropped on a tongue, from whence it is equally distributed at-d-, on the crushing-cylinders of the two mixing-machines. When thouroughly mixed the mortar drops automatically at-f- into the funnels of the stone-presses, at-g-, as a ready made brick, and the fabrication continues as described heretofore.

A novel arrangement and generally preferred in France, is represented on PLAE III. The mixing machine is here replaced by an edgemill in combination with a mixing and conveying screw, into which the material, i. e. the granulated slag and the pulverized slacked lime, are introduced at-a, automatically reaching the edge-mill-b-, from whence it is automatically, too, transmitted into the funnel of the press.

This installation is in some respects preferable to the one on plate II, since:

1) a small plant with but 1 press may be erected.
2) the generally rather severe wear and tear of the elevator is avoided.

We beg to add to the foregoing that we construct as a speciality all the apparatus required in the manufacture of artificial bricks and that a 40 years' experience enables us to supply the very best machines of the kind existing nowadays. All the mixing devices are solidly constructed and of great stability; the conveying-screw is fitted with a steel shaft of 120 mm. sq. and with strong cast iron wings which when worn out can be exchanged, the same as the wings in the mixing-machines can be renewed easily and cheaply. As driving force electricity may be employed everywhere or of course any steam engine.

We call special attention to the annexed prospectus of our brick-presses with a list of committers and we claim as the best proof of the excellence of our machines the fact that some works have successively ordered as many as 6 of them and even more. We dare say that our presses have solely been exceeded by ourselves, since our reinforced construction has replaced the old press, whereof only 1 has since be supplied to a firm who possessed already several of them.

Because of the simplicity of the plants and of the fabrication, the cost of slag bricks is much inferior to that of ordinary clay or calcareous sand-bricks. We have based our estimate of cost and profits on an Installation after plate III, this estimate differing but little from those established on the basis of Plates No. 1 or 2, the cost of 1000 bricks being nearly the same.

Estimate of costs for a factory of slag-bricks as per plate III. with 2 reinforced presses, trough mixing machines and edge-mills.

a) **Buildings:** about 290 m. sq. of ground at ℳ 35.—. ea		ℳ 10150.—
b) **Machinery:**		
1 electromotor, 40 HP	ℳ 2700.—	
2 reinforced brick presses with disengaging device and brake	„ 15300.—	
2 trough mixing-machines with edge-mills	„ 7600.—	
Belting and shafting required	„ 2250.—	
8 brick-cars	„ 520.—	
Sundries and belting	„ 1130.—	
Freight and erecting	„ 1000.—	„ 30500.—
Sum total		ℳ 40650.—
c) **Working capital**		„ 9350.—
		ℳ 50000.—

Estimate OF COSTS AND PROFITS.

a) Amortisation and interest.

2 % amortisation on the building, estimated at ℳ 10150.—	ℳ 203.—
10 % on the machinery estimated at ℳ 30500	„ 3050.—
5 % interest on ℳ 50000.—	„ 2500.—
	ℳ 5753.—

The Factory is supposed only to be working during the frost-free period: 7 months during the year. Each Press supplies in 10 working hours 10000 bricks and, hence, per month of 25 days ea. 250.000 bricks, and, consequently, will 2 Presses mould in 7 months 3.500.000 bricks. Thus the quota for amortisation and interest for 1000 bricks is: $\frac{5753}{3500}$ . . ℳ 1,65

b) Raw Materials.

1. *granulated Slag.* 1000 bricks of the German Standard size 250 × 120 × 65 mm require about 3200 kg of slag, which are supposed to be delivered free to the Works.
2. *Lime:* For 1000 bricks are required according to the condition of the slag from 280 to 320 kg of lime, i. e. on an average 300 kg pulverized slacked lime, cost per 100 kg ℳ 1,50, hence for 100 bricks 3 × 1,50 . . . . . . ℳ 4,50

c) Driving Power, Sundries, Oil and Cleaning Material.

Driving power: For working the Factory with 2 Presses 30 HP are required, on an average costing per hour and HP M. 0.10 and considerably less if generated in the very Factory: thus per day 30 × 10 × 0,10 ℳ 35.— and hence per 1000 bricks $\frac{30}{20}$ . . . . ℳ 1,50

Spare parts, Lubricating and cleaning material, per 1000 bricks at the utmost ℳ 0,50 per 1000 stones . . . . . ℳ 0,50

thus together per 1000 bricks . . . ℳ 2,—

d) Wages.

1.	1 foreman	ℳ	6,—
2.	2 workmen for conveying the slag and lime at ℳ 3,—	„	6,—
3.	2 id. for throwing the material upon the conveying screws at ℳ 3,—	„	6,—
4.	2 id. for removing the bricks out of the presses and placing them on the cars at ℳ 3,50	„	7,—
5.	6 id. for conveying the bricks out of the Factory and heaping them up in the open air, at ℳ 3,—	„	18,—
		ℳ	43,—
	Thus per 1000 bricks $\frac{43}{20}$ =	ℳ	2,15

RECAPITULATION.

a.	Amortisation and Interest	ℳ	1,65
b.	Lime	„	4,50
c.	Driving power and wear & tear etc.	„	2,—
d.	Wages	„	2,15
e.	Office Costs, Insurance fire-and workmens etc.	„	0,70
	Cost of production of 100 bricks	ℳ	11.—

the capital fetching an interest of 5 %.

On constructing a heatable shed, the Factory can continue working also during the mintermonths, thus increasing the yearly output to 6 000 000 bricks and, on introducing night-work, the output can be doubled, producing in either case a reduction of the cost price, the quota for amortisation and interest being less in consequence of the better exploitation of the plant.

Finally as to the quality of the bricks we may safely assert that they can in every respect rival with other good bricks and as slag-bricks are not burnt they do not in the least become deformed, guarding exactly the very shape they presented when coming out of the moulds, the faces being smooth and the edges sharp and rectangular; the height of the several bricks is exactly the same so that they form perfectly straight joints in the brick work. The colour is a greyish withe, so that no plastering of the houses is required, outside. Slag bricks absorb water in a normal way and being possessed of the necessary porosity they are especially recommendable from a sanitary point of view.

In unprejudiced places and chiefly in high furnace Works, the use of Slag Bricks becomes more frequent every year Large manufactories, handsome dwellings, enormous chimneys, and foundations for heavy machines, all is constructed with slag bricks. There are some High Furnace Works who up to date have been supplied with 7 of our presses producing per day about 70 000 bricks. We have hitherto supplied 200 of our presses, by means of which about 2 000 000 slag bricks are moulded per day, which we deem to be the best proof of the excellent quality of the produce and the profits realized by this industry.

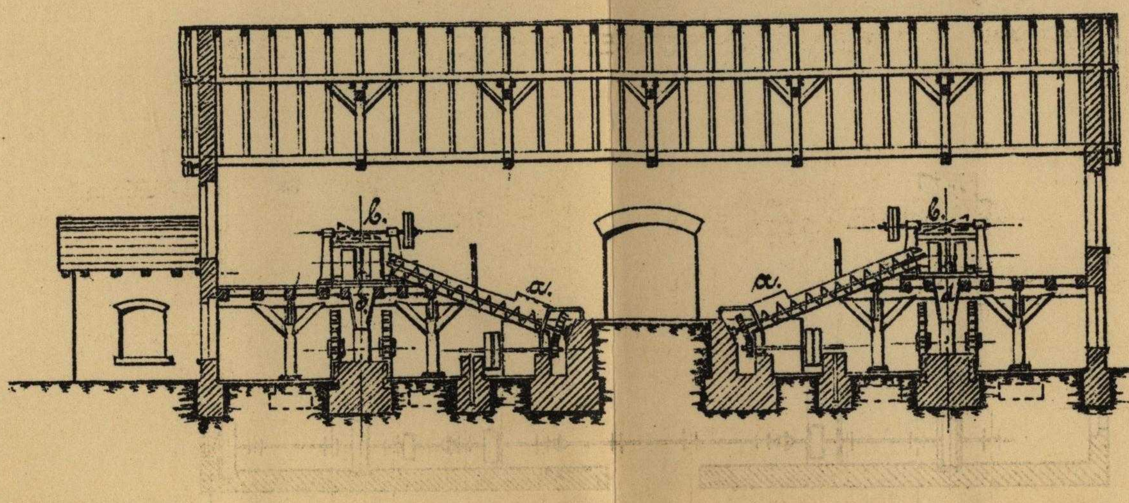
Brück, Kretschel & Co.
Osnabrück.

Plate III.

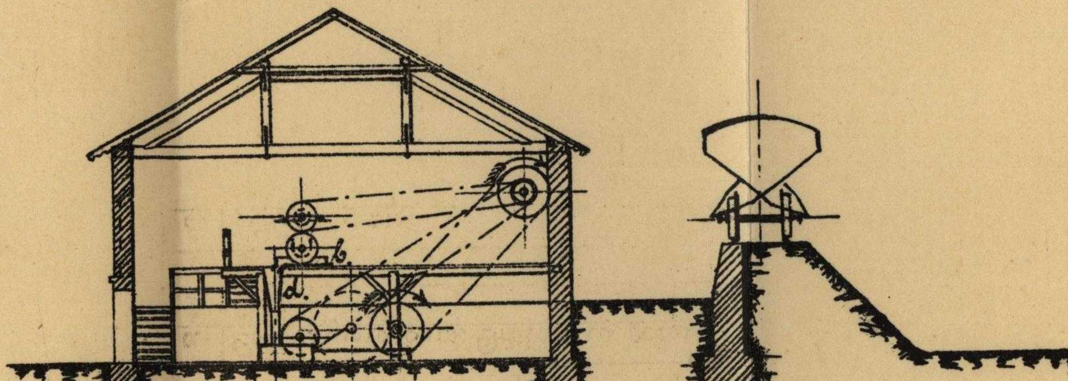
Slag-brick Factory.

1:200 d. w. Gr.

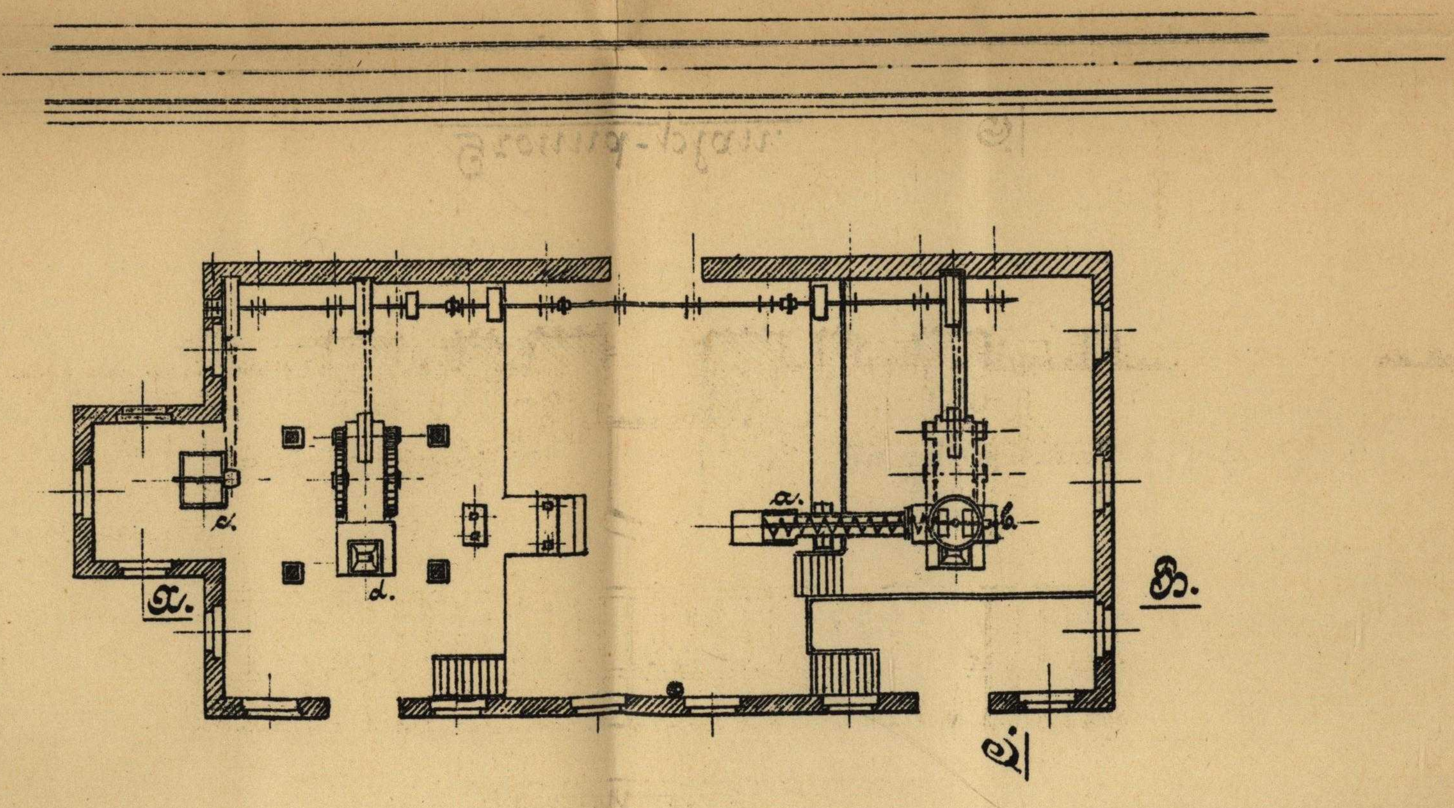
Section after A-B.



Section after C-D.



Ground-plan.



a	Conveying and Mixing screw
b	Edge-mill
c	Motor
d	Brick-press

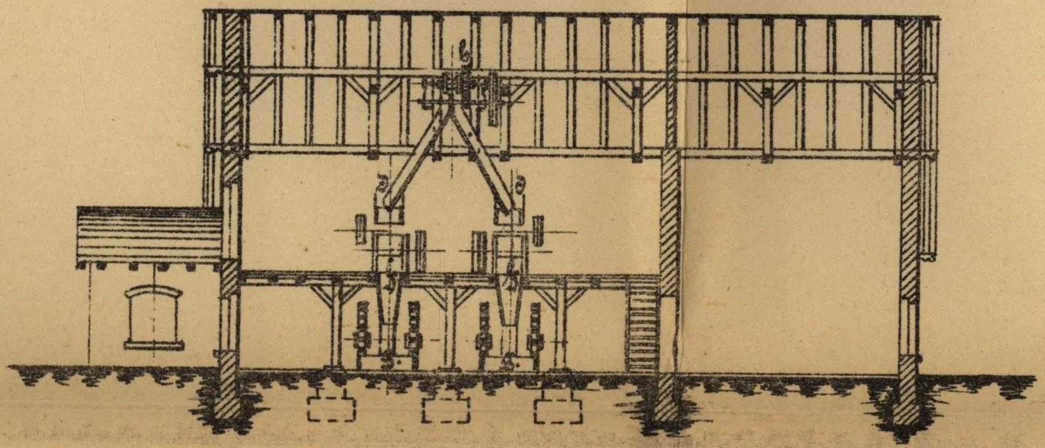
Brück, Kretschel & Co., Osnabrück.

Plate II.

Slag-brick Factory.

1:200 d. w. Gr.

Section after A-B.



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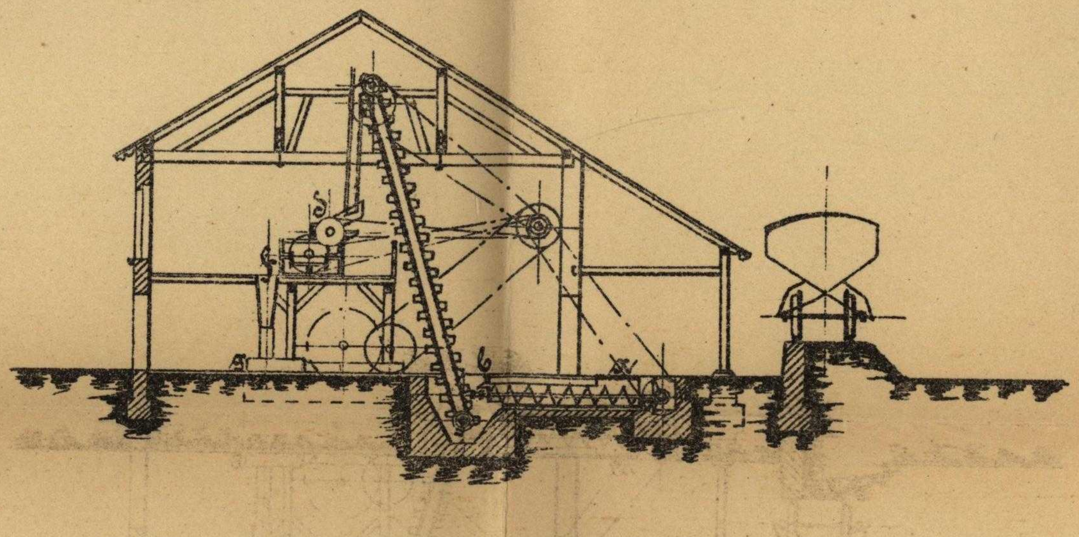

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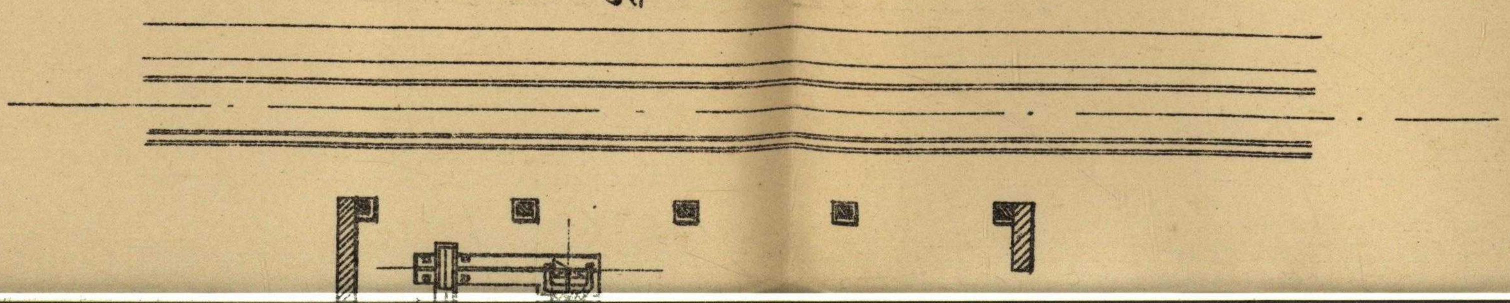
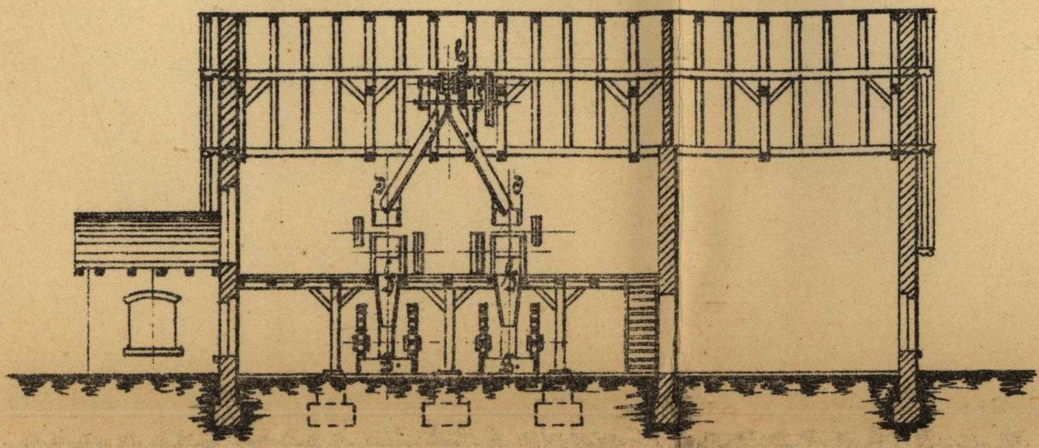


a	Mixing and conveying screw

Section after A-B.



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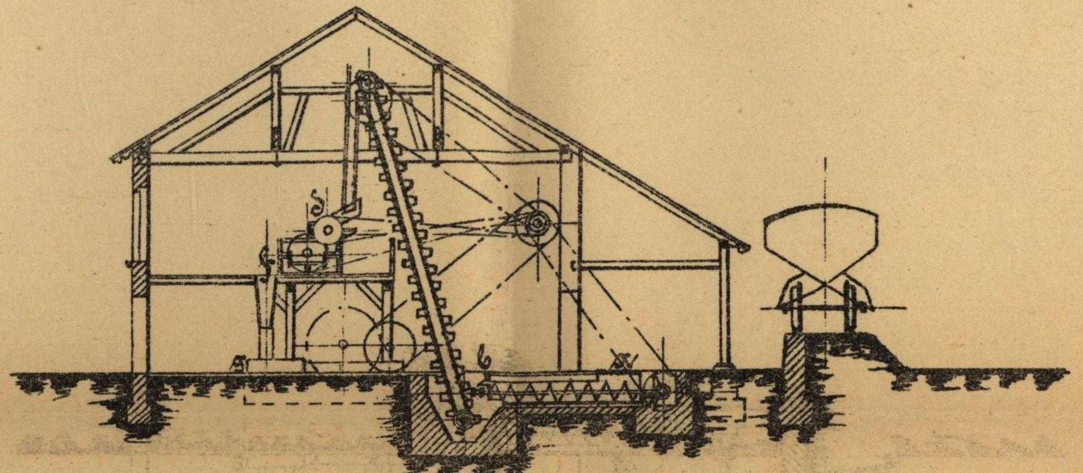

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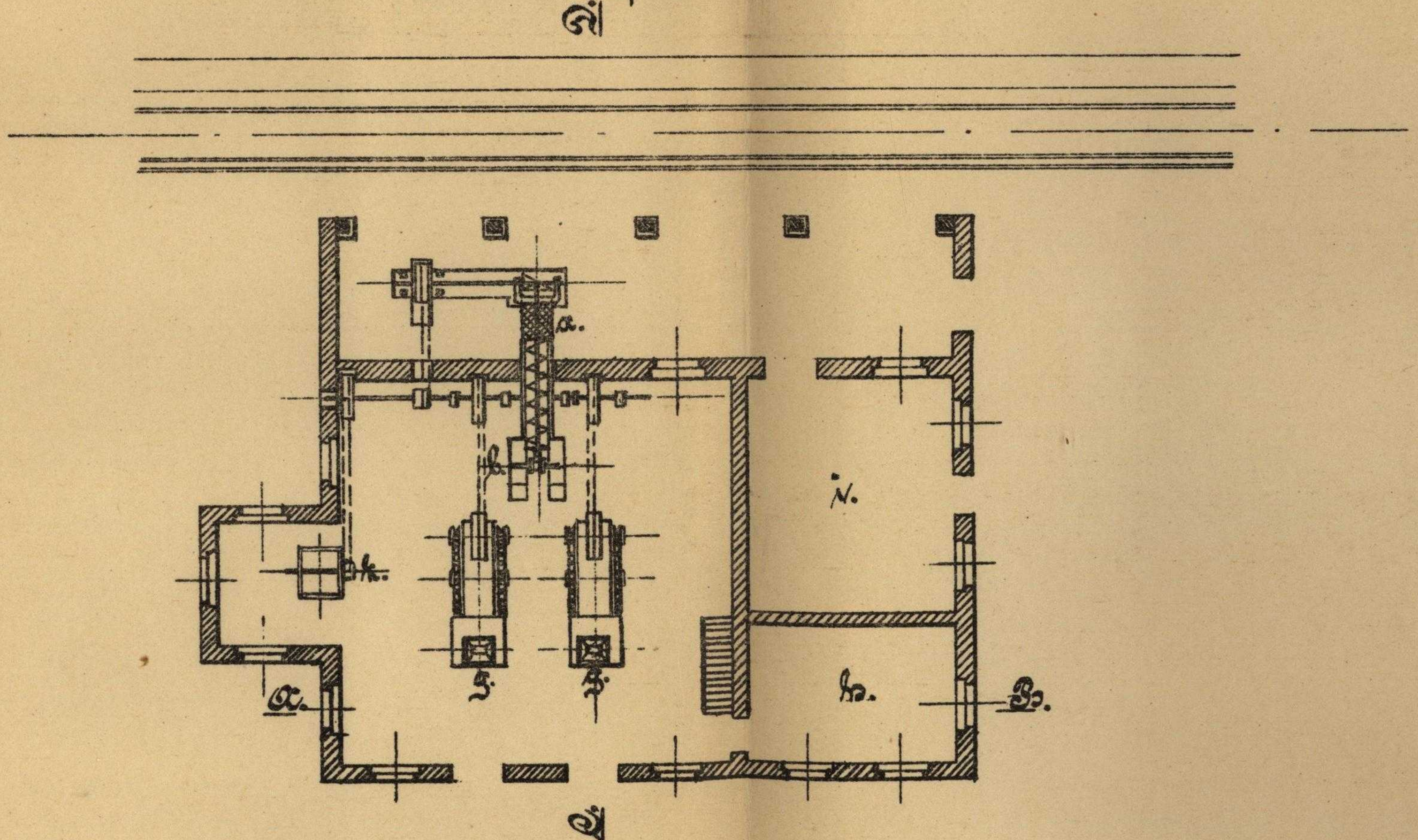

a	Mixing and conveying screw
b	Elevator
d	Crushing-cylinder
f	Mixing machine
g	Brick-press
h	Room for the workmen
i	Space for the lime
k	Motor

Druck v. F. Lahrmann.

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